VNIVERSITAT DE VALÈNCIA

Course Guide
33182 Transgenic organism acquisition

COURSE DATA

DATA SUBJECT

Code: 33182
Name: Transgenic organism acquisition
Cycle: Undergraduate Studies
ECTS Credits: 4.5
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1111 - Grado en Biotecnología	Facultat de Ciències Biològiques	3	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1111 - Grado en Biotecnología	Cellular and molecular methodology	COMPULSORY

COORDINATION

MARTINEZ GIL LUIS

SUMMARY

This course will provide the scientific basis and methodology used to obtain genetically modified organisms (GMOs), particularly fungi, yeasts, plants, invertebrates and mammals. The aim of the practical part of the course is to teach the students some of the techniques most commonly used in laboratories that produce GMOs.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

To take this course you need to have studied or be studying the course Methods in Molecular Biology and Genetic Engineering

COMPETENCES / LEARNING OUTCOMES

1102 -

Saber diseñar y construir un organismo transgénico.

1111 - Grado en Biotecnología

Actuar con autonomía en el aprendizaje, tomando decisiones fundamentadas en diferentes contextos, emitiendo juicios en base a la experimentación y el análisis y transfiriendo el conocimiento a nuevas situaciones

Apply analytical, synthetic and critical thinking skills in the application of the scientific method.

Colaborar eficazmente en equipos de trabajo, asumiendo responsabilidades y funciones de liderazgo y contribuyendo a la mejora y desarrollo colectivo

Conocer las bases químicas y moleculares del funcionamiento celular

Conocer las técnicas básicas que se utilizan para los estudios de expresión génica y para la manipulación del material genético.

Conocer los principios y la metodología básica de la transformación genética de los diferentes organismos

Conocer y comprender, desde el propio ámbito de la titulación, las desigualdades por razón de sexo y género en la sociedad; integrar las diferentes necesidades y preferencias por razón de sexo y de género en el diseño de soluciones y resolución de problemas

Contribuir en el diseño, desarrollo y ejecución de soluciones que den respuesta a demandas sociales, teniendo en cuenta como referente los Objetivos de Desarrollo Sostenible

Demostrar razonamiento crítico y autocrítico en el ámbito de la titulación, considerando aspectos tales como la ética profesional, los valores morales y las implicaciones sociales de las diferentes actividades realizadas

Manejar adecuadamente los equipos y el material propio de un laboratorio de bioquímica y biología molecular

Participate in multidisciplinary teams, engaging in teamwork and collaboration.

Propose creative and innovative solutions to complex situations or problems, typical of the area of ¿¿¿¿connection, to donate responses to the various professional and social needs

Que el estudiantado demuestre su capacidad para calcular correctamente los parámetros relevantes de un proceso o un experimento mediante la representación de los datos experimentales

Saber comunicarse de manera efectiva, tanto de forma oral como escrita, adaptándose a las características de la situación y de la audiencia

Saber cultivar y mantener células in vitro

Ser capaz de diseñar protocolos y utilizar las técnicas del DNA recombinante

Ser capaz de observar e interpretar los resultados obtenidos a través de microscopios ópticos

Use English to write reports and to interpret information from protocols, manuals and databases.

Work in laboratories, including safety procedures, waste management and accurate activity logging.

DESCRIPTION OF CONTENTS

1. Introduction

Basic features about the generation of transgenic organisms

2. Yeast and Fungi

1. Genetic modification of yeast and fungi used in biotechnology. Biotechnological importance of genetic manipulation of yeast and fungi. Cloning in the yeast Saccharomyces cerevisiae: development of vectors, selection markers, introduction of permanent modifications by specific recombination (deletions, changes of promoters and tagged proteins), transformation and verification by PCR of the transformants. Cloning in non-Saccharomyces yeasts. Manipulation of filamentous fungi. Examples of some genetic manipulations in yeast and fungi of biotechnology relevance (improved efficiency in alcoholic beverages production and use of yeasts and fungi as factories).

3. Virus, gene therapy.

2. Gene therapy and genetic modification of viruses. Viruses as carriers of genes: potential applications in human health. How to convert a virus in a vector. General properties of viruses used as vectors: Retrovirus, Lentivirus, Adenovirus, Adeno-associated virus (AAV), Herpes simplex virus. How to combine properties of more than one virus.

3. Defective Non-replicating viral vectors. Retrovirus and lentivirus vector non-replicative. Gene therapy of severe combined immunodeficiency (SCID) with a modified retrovirus. Adenovirus vectors of non-replicative. Clinical applications.Other viruses such as non-replicating viral vectors.

4. Replicating viral vectors. Oncolytic viruses. Adenovirus.

5.Redirectioning of viral vectors. Other therapeutic and biotechnological applications of genetically modified viruses.

4. Transgenic plants

6. Introduction. Traditional breeding versus transgenesis. Methods for introducing foreign DNA in plants. Requirements: In vitro propagation of plants, vectors.

7. Agrobacterium-mediated transformation (A. tumefaciens and A. rizhogenes). Methodology and factors affecting the efficiency of transformation.

8. Transformation by DNA gun. Methodology and factors affecting the efficiency of transformation. Other methods.

9. Characterization of transgenic plants. Transient expression, stable integration. Major applications of transgenic plants.

5. Invertebrates

10.Genetic modification of invertebrates: Drosophila and Caenorhabditis elegans.
Early development and life cycle of Drosophila. Transgenesis in Drosophila: use of transposable elements as transformation vectors, phenotypic markers, microinjection into the germline of embryos, selection of individual transformants.Random or targeted insertion of transgenes. Life cycle of C. elegans.Transgenesis in C. elegans: vectors, microinjection vs. ballistic transformation, selection of individual transformants. Applications of transgenesis in Drosophila and C. elegans for the study of developmental processes and the generation of biomedical models.

6. Mammals

11.Fundamentals of genetic modification in mammals. Generation of transgenic mammals by injection of pronuclei. Fundamentals of reproduction in mammals. Methodology. Design of the transgenes. Use of promoters. Reporter genes. Classic and inducible transgenic animals. Applications of transgenesis in mammals.
12. Mammalian genetic modification using homologous recombination techniques. Fundamentals of early development of mammals and embryonic stem cells. Embryonic stem cell modification. Classic knockouts. Methodology. Knockins. Conditional / tissue-specific and inducible mutants.
13. Introduction of CRISPR methodology in mammals. Origins and historical perspective. Applications for the generation of knockin and knockout mice. Fine genetic editing and modifications that do not affect the gene sequence. Future perspectives of the use of CRISPR technology.
14. Transgenesis in somatic cells in vivo: topical transgenics. Fundamentals of in utero electroporation

technique. Cellular and zone specific transgenesis, multiple transgenesis, functional experiments, electroporation using CRISPR tools. iGonad.

7. Laboratory classes

Informatic class work
1. The transgenic Fly Lab (Howard Hughes Medical Institute)
http://www.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html

It is a computer simulation of the process of generating transgenic flies. Protocol is developed sequentially, and some experiments of microinjection of specific constructs are suggested, whose results should be interpreted.

Lab experiments
1 - Disruption of a gene in a haploid strain of Saccharomyces cerevisiae.
2 - Assays of transient expression in plant tissues
3 - Analysis of reporters in transgenic mice

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	31,00
Laboratory	12,00
Computer classroom practice	2,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	16,50
Independent study and work	0,00
Preparation of lessons	26,00
Preparation for assessment activities	25,00
Resolution of case studies	0,00
Total hours	**67,50**

TEACHING METHODOLOGY

The teaching of this subject is based on several types of teaching activities. Theoretical classes are master classes in which the professor explains the theoretical foundations. The laboratory practices and allow the student to carry out real or virtual activities related to the contents of the course. Seminars allow a deepening in some topics. In all these activities an active participation of the students is expected.

EVALUATION

The evaluation of the course will be in two parts:
Block 1: Review Theoretical / practical. It will consist of a written test that will count up 9 points of the final grade.
Block 2: Includes the evaluation of seminars, workshops and / or memories of practice. This will be done individually or in groups (depending on number of students). It will have up to 1 point of the final grade.
In order to be evaluated is essential to have attended practices, given its mandatory.
To pass the subject must have passed both blocks.
The parties approved of block 2 will be saved during the same academic year and the next one.

REFERENCES

Key References

Benítez-Burraco A (2005) Avances recientes en Biotecnología Vegetal e Ingeniería Genética de Plantas. Reverté, Barcelona.

Brown, T.A. (2004) Gene cloning and DNA analysis: an introduction. 5th ed. Blackwell Science, Oxford.

Izquierdo-Rojo, M. (1999) Ingeniería Genética y transferencia génica. Pirámide, Madrid.

Parekh S.R. (ed.) (2004) The GMO Hanbook. Genetically modified animals, microbes and plants in Biotechnology. Humana Press Inc., New Jersey.

Primrose, S.B., Twyman, R. (2006) Principles of genetic manipulation and genomics. 7th ed. Blackwell Science, Oxford.

Singer, M. y Berg, P. (1993) Genes y genomas: una perspectiva cambiante. Omega, Barcelona.

Slater A, Scott N, Fowler M (2008). Plant Biotechnology. The genetic manipulation of plants. Oxford University Press, Oxford.

Hogan BLM, Beddington RSP, Costantini FL (1994) Manipulating the mouse embryo. A laboratory manual. Cold Spring Harbor, NY.: Cold Spring Harbor Laboratory Press.

Complementary references

Ashburner, M., Golic, K.G., Hawley, R.S. (2005). Drosophila: A Laboratory Handbook, Second Edition. Cold Spring Harbor Laboratory Press, New York.

Bhojwani SS, Razdan MK (1996). Plant Tissue Culture: Theory and Practice, a Revised Edition. En: Studies in Plant Science 5. Elsevier, Amsterdam.

Carroll D.J. (2008). Microinjection: Methods and Applications (Methods in Molecular Biology). Humana Press Inc., New Jersey.

Dahman C. (2008). Drosophila: Methods and Protocols (Methdos in Molecular Biology). Humana Press Inc., New Jersey.

George EF 1993 Plant Propagation by tissue culture.(Parts I and II) 2nd ed. Exegetics Ltds England

Murray DR (2003) Seeds of concern. The genetic manipulation of plants. CABI Publishing, Wallingford. Potrykus I, Spangerberg G 1995 gene transfer to plants.

Potrykus I and Spangerberg G (eds.) Springer- verlag Berlin.

Websites

htpp://croptechnology.unl.edu

htpp//www.isaaa.org http://www.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html

http://www.jove.com/index/details.stp?ID=833

http://www.wormbook.org

http://www.currentprotocols.com

https://web.mit.edu/compmed/Restrict/CAC/training_new.htm

http://www.jax.org/courses/events/current.do